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Effectiveness of fiberglass glass bur, ultrasonic and manual mechanotherapy on grade II furcation involved mandibular molars (An in vivo comparative study)

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Abstract

Background: Access to the molars furcation areas is especially difficult for the patient and clinician alike due to the posterior location of molars, the dimension and position of furcation entrances, and the internal furcation surfaces that are frequently concave or irregularly contoured. The disparity between the size of commonly used scaling instruments and the size of the furcation entrance further complicates the situation.

Materials and Methods: Thirty grade II furcation involved first and second mandibular molar teeth from seventeen patients. The clinical parameters that were measured included, Plaque index PI, Gingival index GI, Bleeding on probing BOP, Probing pocket depth PPD and Relative attachment level RAL. The furcation involved teeth included in the study were allocated in 3 groups according to the type mechanical treatment used. **GROUP A (GA)** :10 teeth treated by hand instrumentation by gracey curette. **GROUP B (GB)**: 10 teeth treated by fiberglass rotary burs. **GROUP C (GC)** : 10 teeth treated by ultrasonic scaler with special furcation tip. The clinical parameters were recorded at day (0) (baseline visit,) prior to surgical operations and repeated at (4 weeks), and (12 weeks) after operations. **Results: GROUP A, GB, and GC at (12 weeks) were respectively as the following: PLI (1.28, 1.03 and 0.56)**, **GI (0.97, 1.12 and 0.60), BOP (37.88 %, 39.44 % and 11.66 %), PPD (3.11 mm, 2.8 mm and 1.28 mm)** and **RAL (3.36 mm, 3.47 mm and 2.7 mm).**

Conclusions: GROUP C Ultrasonic scaler revealed the highly significant reduction in the clinical parameters. Followed by fiberglass burs and lastly by the curette. Also the three groups showed a highly significant reduction in all parameters as the time interval progressed (4 weeks), and (12 weeks).

Key words: Furcation, Fiberglass , Ultrasonic, mechanotherapy, mandibular molars.

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Introduction

Periodontitis is defined as an inflammatory disease of the supporting tissues of the teeth caused by specific microorganisms or groups of specific microorganisms, resulting in progressive destruction of the periodontal ligament and alveolar bone with pocket formation, recession, or both [1]. Since the primary etiologic factor in periodontal disease is dental plaque, the outcome of periodontal therapy is in general good and predictable, if the clinician and the patient can adequately access root surfaces to remove the bacterial plaque [2]. Periodontal scaling procedures "include the removal of plaque, calculus and stain from the crown and root surfaces of teeth, while root planing is a specialized skill involving scaling of the root of the tooth, made up of cementum. Because cementum is softer than enamel, it is affected more by ongoing build-up and inflammatory byproducts. A smooth cementum provides less opportunity for bacteria to accumulate and form calculus. So root planing is an important part of stopping the progression of periodontal disease, especially once deeper pockets have formed in the gums, which is really in the bone. Thus root planing is a specific treatment that removes the roughened cementum and surface dentin that is impregnated with calculus, microorganisms and their toxins. [3-5]

Among the factors that make molars particularly susceptible to periodontal disease include accumulation of bacterial plaque, as a result of difficult access to oral hygiene procedures. Access to the furcation areas is further complicated by the posterior location of the molars, the disparity between root and furcation anatomies, and the shape and dimension of the debriding instruments. Root debridement is consequently very difficult and inefficient in furcations [6].

Traditional therapy aimed at alleviating the inflammatory lesion by eliminating soft and hard tissue deposits in the furcation area using scaling and root planing (SRP) should be the starting point in treating furcation defects. The efficacy of scaling and root planing at the furcation area can be improved using ultrasonic scaler inserts [7] . With proper postoperative maintenance care, this simple treatment may be successful in treating many a molar defects in particular in the maxillary area. Conservative surgical therapy, such as Modified Widman flap or flap with minor osseous resection can improve access to the furcation for better debridement by the clinician and easier home-care for the patient [8,9].

Sonic and ultrasonic scalers are powered by a system that causes vibration of the tip. Sonic scalers are powered by an air-driven turbine. Ultrasonic scalers are of two types, either magnetostrictive or piezoelectric systems to create vibration. Their mechanism of action is different. Magnetostrictive units operate between 18 kHz and 45 kHz using flat metal strips in a stack or a metal rod attached to a scaling tip, and the tip movement is elliptical. Piezoelectric units operate in the 25 kHz to 50 kHz range and are reactivated by dimensional changes in the crystals housed within the hand-piece as electricity passes over the surface of the crystals; tip movement is primarily linear in direction . Ultrasonic scalers also include a liquid output or lavage, which aids in cooling the tool during use, as well as rinsing all the unwanted materials from the teeth and gum line. The lavage can also

be used to deliver antimicrobial agents [10].

Rotary instruments for scaling and root planing have been developed. Previously, a carbide bur and a diamond point were used at high-speed rotation for polishing. However, these rotating instruments have been reported to be associated with an increased risk of damaging the root surface and soft tissues [11]. The sonic scaler, in which a hexagonal pyramid chip is installed on an air turbine for high-speed rotation, may damage the gingival tissues or the dentin if used incorrectly, and this instrument is thus no longer in general use [12,13]. Recently, other rotary instruments have been developed for root planing, like the fiberglass rotary burs by which the problem of damage the gingival tissues or the dentin is overcome [14].

The management of furcation involvement presents one of the greatest challenges in periodontal therapy. Furcation-involved molar teeth respond less favorably to conventional periodontal therapy, and molars are lost more often than any other tooth type. Access to the molars furcation areas is especially difficult for the patient and clinician alike due to the posterior location of molars, the dimension and position of furcation entrances, and the internal furcation surfaces that are frequently concave or contoured. The disparity between the size of commonly used scaling instruments and the size of the furcation entrance further complicates the situation [14,15].

Specially shaped scalers or curettes are the instruments used to clean root surfaces affected by periodontal disease. Ultrasonic scalers, which use high-frequency vibrations and streaming water or disinfectant liquids like (chlorhexidine) to loosen and flush debris and biofilm, play a critical role in treatment. Topically or locally applied antimicrobials and antibiotics have also proven helpful as part of a routine maintenance regime in trying to disinfect and stabilize the furcations, but their effectiveness may be limited [16].

As a result of the mentioned different mechanical treatment modalities of furcation-involved molar teeth, the present study was carried out to evaluate the efficacy of three mechanical instrumentation procedures (manual, ultrasonic and fiberglass rotary burs) and make a comparison among their effectiveness in treatment of grade II furcation involved first and second mandibular molars.

Materials and Methods

The sample selection for the study was the patients who attending the teaching hospital / periodontics department at the college of dentistry, AL-Mustansiriya University, for treatment of chronic periodontitis. Thirty grade II furcation involved first and second mandibular molar teeth from seventeen patients (9) males and (8) females with an age range of (32-50 years), the mean age was (41.9). All the patients had good health, free from any systemic disease, not taken any medication that may affect periodontal health, had not received any periodontal treatment (scaling or root planing) in the preceding 2 years and he was not taken any systemic antibiotic for the last 6 months. The patients selected for the study should have grade II furcation involved mandibular molars. Before baseline examination any defect restoration, ill fitted margin of a restoration, or caries proximally or near gingival third was treated and restored with permanent fillings. Also an alginate impression was taken and an occlusal stent was constructed for each patient using cold cure acrylic for

measurement of relative attachment level.

A split mouth randomized study was carried out before baseline examination; all patients received a supragingival debridement consisting of scaling and polishing, in addition to instructions in an effective oral hygiene regimen of daily brushing and use other interdental cleaning aids. Plaque control was reinforced depending on individual needs in series of visits before baseline and clinical parameters recording. Those parameters included, Plaque index PI, Gingival index GI, Bleeding on probing BOP, Probing pocket depth PPD and Relative attachment level RAL. The furcation involved teeth included in the study were allocated in 3 groups according to the type mechanical treatment used.

GROUP A : Ten teeth treated by hand instrumentation by gracey curette 17/18.

GROUP B: Ten teeth treated by fiberglass rotary burs. (Figure 1 fiberglass burs)

GROUP C : Ten teeth treatedby U/S scaler with special furcation tip.

The clinical parameters were recorded at day (0) (baseline visit,) prior to surgical operations and repeated at (4 weeks), and (12 weeks) after operations. l//

After baseline clinical parameters recording, first instrumentation procedure was done in the same visit for each treatment modality. The average time of instrumentation per tooth required for each method of instrumentation was calculated. The instrumentation of furcation involved teeth was performed by one experienced operator. The procedure that was performed to the working sites in all involved teeth is modified widman flap local anesthesia, the only difference was in the step of root planing. This step was performed using gracey curettes or ultrasonic device, or using the newly designed motor-driven rotating fiberglass burs. These burs were used with an ordinary slow handpiece with continuous irrigation of the root surface with normal saline as a coolant to prevent excessive heat generation so as not to induce any harmful effect on the dentine and pulp tissue. The procedure ended until the operator felt that root surfaces were debrided and planed by using of dental explorer felt hard and smooth root surfaces. Statistical analysis comprised of analysis of variance (ANOVA) one way. The comparison of the mean score between two independent groups at baseline visit and their values at each subsequent visits(4weeks & 12 weeks) was undertaken using the paired t-test paired samples (inter-group comparison) .Chi-square test used for comparing the percentages of bleeding on probing. The differences were considered significant when the probability (P) level is equal to or less than 5% ($P < 0.05$) and when the probability (P) was more than 5% ($P > 0.05$) it was regarded as non significant (N.S), while values less than 0.01 were regarded as highly significant ($P < 0.01$).

Results

Seventeen patients have been involved in this study, each patient received root planing using gracey curette, fiber glass burs and U/S scaler with special furcation tip. A total of (30) teeth received root planing by gracey curette (group A-10 teeth) & by fiberglass burs (group B-10 teeth) and by U/S scaler (group C-10 teeth). All patients completed the trial and attended all the recall visits as initially designed.

(Table-1) shows the mean and SD of plaque index at **(Day 0, 4 weeks & 12 weeks)** in **group A the mean**

values were (2.61, 1.72 and **1.28)** respectively. The mean values of **group B (2.54, 1.71 and 1.03)** respectively. **For group C (2.42, 1.02** and **0.56)** respectively**.**

The mean plaque score for the patients was high in the baseline examination then reduced with significant differences among the subsequent visits regarding the gracey curette and fiberglass bur while the instrumentation with U/S demonstrated a highly significant difference at different visits.

Regarding the gingival index ***(Table -2)*** reveals the U/S scaler (group C) showed marked reduction in the mean at different visits with highly significant differences followed by the group A&B of instrumentation that demonstrate highly significant differences among visits. The mean values of gingival index at **(Day 0, 4 weeks & 12 weeks)** for **group A were (2.15, 1.35 and 0.97) respectively. Group B (2.02, 1.57 and 1.12) respectively. Group C (2.21, 0.71 and 0.60) respectively.**

(Table 3) shows the mean and SD of probing pocket depth index at (baseline visit and their values at each subsequent visits 4 weeks & 12 weeks). The mean pocket depth for **group A was (5.71, 3.98 and 3.11) respectively. in GB the PPD values were (6.12mm, 3.88 mm and 2.8 mm) respectively. While for GC (5.46 mm, 2.88 mm and 1.28 mm)**

(Table 4) demonstrates the mean and SD of relative attachment level for the groups of treatments at all visits. The study showed that the mean of relative attachment level at the subsequent visits were reduced with significant difference regarding the A & B groups and highly significant reduction in the C group of instrumentation. At (baseline visit and their value at each subsequent visits 4weeks & 12 weeks) **Relative attachment level for GA (6.91 mm 4.96 mm 3.36 mm) respectively. Regarding GB (6.84 mm, 3.87 mm and 3.47mm) respectively. In GC (6.84mm, 2.14 mm and 2.7 mm) respectively.**

Then there was highly significant reduction of bleeding at different visits for the three groups of instrumentation with marked reduction showed by group C (Table 5).The percentages of bleeding on probing at **Baseline, 4 weeks and 12 weeks** were for **group A (100% 68.98% 37.88%) respectively. For GB (100%, 71.36% and 39.44) respectively. While for GC (100 %, 50.87 % and 11.66 %) respectively.**

The comparison among the 3 groups regarding PLI, GI, BOP, PPD & RAL at different visits **(table 6 & 7)** revealed that there were no significant differences between the two methods of treatment (A&B) at (4weeks) and (12weeks) examination. While the comparison between A&C, B&C groups showing significant and highly significant differences at each subsequent visits (4 weeks & 12 weeks).

The results also demonstrated that the meantime required for root planing and furcation debridement with hand instrumentation (4.55) minutes per tooth and for fiberglass burs was (3.09) minutes per tooth, while in ultrasonic instrumentation the mean time required was (2.1) minutes per tooth with a highly significant difference among them **(Figure 2).**

Discussion

The treatment of molar furcation defects remains a considerable challenge in clinical practice. The identification of clinical measurements influential to treatment outcomes is critical to optimize the results of surgical periodontal therapy. Anatomic

factors such as furcation areas that favor plaque accumulation are known to contribute to progression of periodontal disease. Regeneration / healing of the involved furcation is complicated by the presence of developmental anomalies in the furcation areas such as cervical enamel projection, intermediate bifurcational ridge, root fusion, enamel pearls and root concavities [17].

However, there is still inadequate literature documenting the normal anatomy of the furcation. Existing anatomic classifications are based on two dimensional measurements that may not truly reflect the complexity of the furcation area [18].

The current study is the first one that compared between fiberglass burs and ultrasonic instrumentation. A split mouth randomized study was carried out before baseline examination; all patients received a supragingival debridement consisting of scaling and polishing, in addition to instructions in an effective oral hygiene regimen. Plaque control was reinforced depending on individual needs in series of visits before baseline and clinical parameters recording.

The results of the present study revealed the superiority of the U/S SRP over the hand and fiberglass burs instrumentation in treatment of grade II furcation involved mandibular first molar. This is in agreement with [19] and disagrees with Foteini V.et al 2007 [9]

There was a significant difference in the mean of PLI & GI among the different visits of the two methods of gracey curette and fiberglass bur with a highly significant difference regarding the treatment with U/S SRP. All examined surfaces showed bleeding on probing at baseline examination.

At (4 week) visit there was a reduction in the percentage of sites that bled on probing for the two methods of instrumentation and marked reduction in bleeding for the U/S SRP compared with the baseline examination. This was in accordance with other studies that used hand and ultrasonic instrumentation Badersten A. et al [20] , Copulos TA, et al [21] and Ismail MN 2000 [22].

There was a continuous improvement in gingival bleeding at (12 week) examination with highly significant differences among visits.

The findings of the study indicated that there was a marked reduction with highly significant differences in probing pocket depth for U/S SRP at the end of the study (12 week) visit. Also there was a marked improvement in relative attachment level for U/S SRP of root planing with highly significant differences among visits.

The comparisons among the 3 groups of treatment in PLI, GI, BOP, PPD &RAL at (4 weeks & 12 weeks) revealed significant and highly significant differences when U/S SRP compared with curette and fiberglass bur, with no significant differences between the two types of treatment (A&B).

The results of our study demonstrated that U/S root debridement leads to a significant improvement in all clinical parameters. These outcomes can be explained by the fact that the positive property of vibration of scaler tips is the main effect to remove the deposits from the dental surface such us bacterial plaque, calculus and endotoxin. However, constant flushing activity of lavage use to cool of the tip and cavitational activity result in disruption of the weak and unattached subgingival plaque in addition to an advantageous property of the possibility of using an antibacterial solutions like chlorhexidine or cetyl pyridinium chloride to exaggerate and improve the efficacy of mechanotherapy of the U/S

debridement [23]. Basically, there are two types of power driven scalers. Sonic scalers are powered by compressed air and operate at lower frequencies which range between 3000 to 8000 cycles per second. An example of this type of scaler is the Star Titan sonic scaler. Ultrasonic scalers are divided into two types. Magnetostrictive ultrasonic scalers operate between 18000 and 45000 cycles per second .These properties provided the sonic and ultrasonic scalers the advantage of time saving over the manual SRP [24]

From the findings of this study ultrasonic debridement was significantly more effective than hand scaling and these results were in agreement with studies of Linda E. Leon and Richard I. Vogel [25] & Bower RC [26], they reported that the ultrasonic (smaller) tip would fit better than the tip of a Gracey curette in a grade II or III furcation involvement.

Conclusions

In conclusion power driven instruments have many advantages over the manual scalers; however further studies are needed to improve the performance of currently valuable instrument. These include the development of a more effective tip and ultrasonic generator unit. Long term randomized controlled studies are also required to examine the efficacy of newly designed scalers. These studies would help to provide treatment based on exact information regarding the instrument and technology [27] .

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Table (1): Mean plaque index for the 3 groups of instrumentation at different visits.

Study Groups	Baseline		4 weeks		12 weeks		F	Significance
	Mean	SD	Mean	SD	Mean	SD		
A	2.61	0.49	1.72	0.45	1.28	0.2	10.4	**(P< 0.05)* Sig.**
B	2.54	0.50	1.71	0.42	1.03	0.1	12.3	**(P< 0.05)* Sig.**
C	2.42	0.38	1.02	0.23	0.56	0.1	37.5	**(P< 0.00)*H.Sig**

Table (2): Mean gingival index for the 3 groups of instrumentation at different visits

Study Groups	Baseline		4 weeks		12 weeks		F	Significance
	Mean	SD	Mean	SD	Mean	SD		
A	2.15	0.33	1.35	0.22	0.97	0.15	13.76	**(P< 0.05)* Sig.**
B	2.02	0.34	1.57	0.23	1.12	0.16	9.33	**(P< 0.05)* Sig.**
C	2.21	0.48	0.71	0.18	0.60	0.15	24.73	**(P< 0.000)*H. Sig.**

Table (3): Mean probing pocket depth for the 3 groups of instrumentation at different visits.

Study Groups	Baseline		4 weeks		12 weeks		F	Significance
	Mean	SD	Mean	SD	Mean	SD		
A	5.71	1.9	3.98	0.89	3.11	0.45	9.63	**(P< 0.05)* Sig.**
B	6.12	1.5	3.88	0.49	2.8	0.38	19.5	**(P< 0.05)* Sig.**
C	5.46	1.4	2.88	0.78	1.28	0.26	39.3	**(P< 0.000)* H.Sig.**

Table (4): Mean relative attachment level for the 3 groups of instrumentation at different visits.

Study Groups	Baseline		4 weeks		12 weeks		F	Significance
	Mean	SD	Mean	SD	Mean	SD		
A	6.91	1.13	4.96	0.83	3.36	1.38	9.3	**(P< 0.05)* Sig.**
B	6.84	1.15	3.87	0.65	3.47	1.11	7.52	**(P< 0.05)* Sig.**
C	6.84	1.45	2.14	0.73	2.7	0.81	31.33	**(P< 0.000)* H.Sig.**

Table (5): Mean percentage of bleeding of probing for the 3 groups of instrumentation at different visits.

Study Groups	Baseline	4 weeks	12 weeks	Chi	df	Significance
	%	%	%			
A	100	68.98	37.88	79.36	1	**(P< 0.01)*H. Sig.**
B	100	71.36	39.44	81.36	1	**(P< 0.01)*H. Sig.**
C	100	50.87	11.66	322.36	2	**(P< 0.000)*H. Sig.**

Table 6: Shows the comparative differences among the 3 groups in PLI, GI & BOP at different visits.

PLI	**4 weeks**	**T-test**	**P- value**		**12 weeks**	**T-test**	**P- value**
	GA/GB	1.44	0.152 NS		GA/GB	1.32	0.24 NS
	GA/GC	3.77	0.009		GA/GC	2.44	1.725 S
	GB/GC	4.09	0.010		GB/GC	3.77	0.009 S
GI	**4 weeks**	T-test	P- value		12 weeks	T-test	P- value
	GA/GB	1.78	0.152 NS		GA/GB	1.72	0.24 NS
	GA/GC	4.97	0.010 HS		GA/GC	12.96	0.007 HS
	GB/GC	5.29	0.0002HS		GB/GC	63.77	0.009 HS
BOP	**4 weeks**	df	Chi	P	12 weeks	df	Chi	P
	GA/GB	1	1.067	0.59	GA/GB	1	1.24	0.24 NS
	GA/GC	2	431.3	0.00	GA/GC	2	81.36	0.000 HS
	GB/GC	2	321.3	0.00	GB/GC	2	422.36	0.000 HS

Table 7: Shows the comparative differences among the 3 groups in PPD & RAL at different visits.

PPD	**4 weeks**	**T-test**	**P**	**12 weeks**	**T-test**	**P**
	GA/GB	1.44	0.152 NS	GA/GB	1.32	0.154 NS
	GA/GC	3.77	0.009	GA/GC	2.44	0.001 HS
	GB/GC	4.09	0.010	GB/GC	3.77	0.009 HS
RAL	**4 weeks**	T-test	P	12 weeks	T-test	P
	GA/GB	1.14	0.152 NS	GA/GB	1.32	0.24 NS
	GA/GC	31.6	0.009	GA/GC	21.44	0.000 HS
	GB/GC	54.39	0.000	GB/GC	37.77	0.009 HS

Sig. = Significant HS = Highly significant NS = Non significant

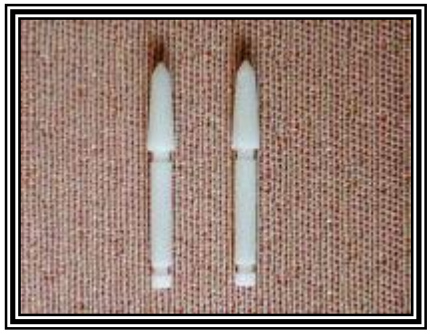

Figure (1): The fiber glass burs.

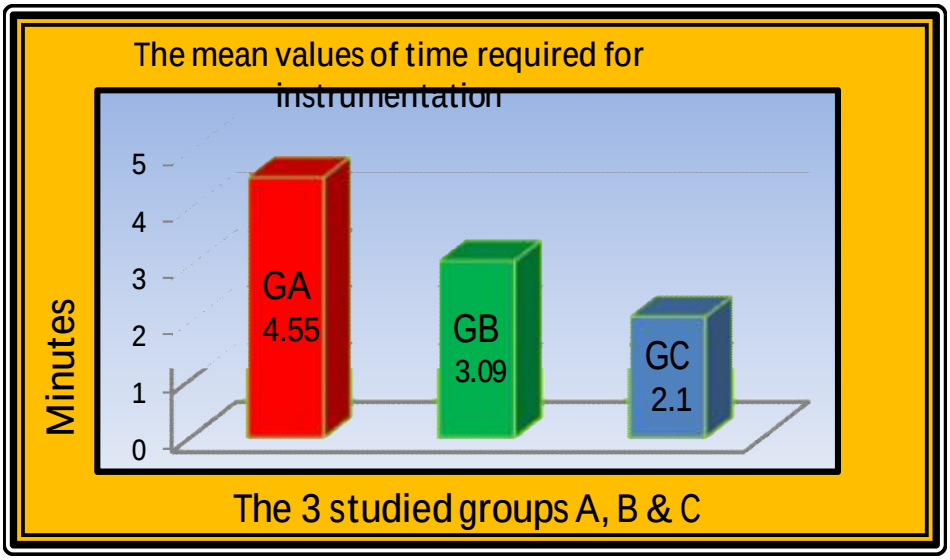

Figure (2): The mean values of the time required for root planing and furcation debridement.